

## AN ADHESIVE FABRIC

This invention relates to an adhesive fabric that adheres to the body.

- 5 This invention also relates to hold-up hose, in particular stockings or half-hose such as a knee-high

Narrow fabrics comprising friction-generating materials are used to attach garments and accessories onto the body. For example, in hosiery  
10 elastomeric narrow fabrics retain "stay-up" stockings in position.

This is currently achieved by forming around the internal opening of the stocking one or more annular bands of a silicone elastomer having a high coefficient of friction and a high modulus of elasticity. The bands act to  
15 hold up the stocking by applying a constrictive force, such as that generated from an elasticated ring or strap in order to maximise frictional grip.

While the above may achieve good garment positioning, it is undesirable as it can also cause discomfort and pain to the wearer. After an extended  
20 wearing period, and/or if the annular band of elastomer is a particularly tight fit, the narrow band will press into the wearer's flesh causing pain, localised temporary damage and reduced blood circulation.

According to one aspect of the invention there is provided an adhesive  
25 fabric capable of adhering to the skin of a body, comprising: a barrier layer bonded on one side of a fabric substrate and a cured adhesive silicone gel layer bonded to the barrier layer whereby the barrier prevents absorption of the adhesive silicone gel coating into the fabric substrate.

According to another aspect of the invention there is provided a hose having a tubular body formed from a fabric, the tubular body having at one end a leg opening, the fabric in the region of the leg opening being provided with an adhesive coating capable of adhering to the skin of a wearer.

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The fabric substrate or the fabric in the region of the leg opening may be a woven, a non-woven or a knitted fabric. The knitted fabric may be knitted from non-elastomeric yarns only such as polyamide or polyester or may be knitted incorporating elastomeric yarns such as an elastane in order to 10 provide the fabric with a desired modulus of elasticity.

The adhesive fabric may be re-usable, whereby lost adhesion is re-generated by washing the adhesive fabric in a conventional manner.

15 The thickness of the barrier layer is preferably chosen to be sufficient to ensure that an impervious layer is formed. Accordingly, for fabric substrates which are smooth and non-hairy, a thinner barrier layer may be adopted compared to a fabric having a rough and/or hairy surface. For fabrics having a hairy surface, it is desirable for the barrier layer to be thick 20 enough to encapsulate therein the surface hairs in order to prevent the hairs acting as wicks.

Typically, it is envisaged that the barrier layer will have a thickness in the range of 0.05 to 0.5 mm, more preferably in the range of 0.1 to 0.3 mm, 25 more preferably 0.15 to 0.225 mm.

In addition to permeability of the barrier layer, the thickness of the barrier layer when composed of a silicone elastomer is also chosen bearing in mind the degree of elasticity it is desired to provide to the fabric substrate, i.e. the

thicker the barrier layer the greater the power of stretch recovery imparted to the fabric substrate.

The thickness of the silicone gel layer is preferably chosen to provide a  
5 desired degree of adhesion to, for example, the skin of a body. Generally,  
the adhesive power is a function of thickness, viz. the thicker the layer of  
silicone gel, the greater the adhesive power.

Typically, the thickness of the silicone gel layer is chosen to be in the range  
10 of 0.01 to 0.5 mm, more preferably 0.2 to 0.4 mm, more preferably 0.3 to  
0.33 mm.

There is further provided a method for manufacturing an adhesive fabric including:  
15 extruding a layer of a curable barrier material onto a fabric substrate; curing the barrier material to form a barrier layer; extruding a layer of a curable adhesive silicone gel on top of the barrier layer and curing the adhesive silicone gel.

Preferably the barrier layer is a silicone elastomer and the silicone gel is  
20 extruded onto the silicone elastomer before it is cured so that curing of both  
the silicone elastomer and gel is performed simultaneously.

Various aspects of the invention are hereinafter described with reference to  
the accompanying drawings, in which –

25 Figure 1 is a schematic perspective view of a first embodiment according to the invention;

Figure 2 is a schematic perspective view of a second embodiment according to the invention;

30 Figure 3 is a schematic perspective view of a third embodiment according to the invention;

Figure 4 is a schematic side view of the production of an adhesive fabric strip 10 for incorporation into the first embodiment of the invention.

A hose 30 according to a first embodiment of the invention is illustrated in 5 Figure 1, a hose 50 according to a second embodiment of the invention is illustrated in Figure 2 and a hose 70 according to a third embodiment of the invention is illustrated in Figure 3. Parts common to all embodiments are defined by the same reference numerals.

10 The hose 30 includes a tubular body 32 which is preferably closed at one end to define a first accommodating region 34. The opposite end of the tubular body 32 is open to define a leg opening 36.

15 On the interior of the tubular body 32 and located in the vicinity of the leg opening 36 there is provided an adhesive coating 20.

In the embodiment of Figure 1, the adhesive coating 20 is arranged to define a continuous band 22 which extends circumferentially about the leg opening 36.

20 In the second embodiment 50 illustrated in Figure 2, the coating 20 is arranged in a series of discrete regions 24 of adhesive; the discrete regions 24 being spaced about the circumference of the leg opening 36.

25 The adhesive coating is preferably formed from a pressure sensitive adhesive which preferably remains permanently tacky; in other words an adhesive which can be adhered and removed to a surface many times. Preferably the adhesive also provides an adhesive bond which is strongly resistive to shear forces but which is relatively weak to peel forces. The 30 coating 20 may be applied so as to define a continuous layer of adhesive or

alternatively a discontinuous layer of adhesive, i.e. the layer may contain small holes to thereby provide the layer with a desired degree of air permeability. This may be achieved by applying the adhesive using spraying techniques. In addition or alternatively, if the fabric is an open fabric such as lace, the adhesive may be applied using the technique disclosed in our European patent 0922130 such that the holes in the fabric remain open after application of the adhesive.

Preferably the adhesive coating 20 is defined by a silicone gel which is adhered to a fabric substrate by a barrier layer formed of a silicone elastomer (as hereinafter more fully described with reference to Figure 4).

It is also envisaged that the silicone elastomer and gel may be intimately mixed prior to application to the fabric substrate and then quickly cured.

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Alternatively, the adhesive coating 20 may be defined by an acrylic pressure sensitive adhesive such as a water based acrylic pressure adhesive, e.g. "tackwhite A4 MED" as supplied by Ichemco Srl, Italy.

20 The area of fabric coated with the adhesive coating 20 is chosen such that the desired degree of support may be achieved taking into account the resistance to shear provided by the adhesive. Typically for stockings, it is expected that the band 22 will have a width within the range of 10 to 60 mm.

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Typically for knee-highs, it is expected that the band 22 will have a width within the range of 5 to 30 mm.

30 It is envisaged that the region of fabric 28 which carries the adhesive coating 20 and which defined the leg opening 36 may be a separate strip of

fabric, such as a lace strip or a strip of plain fabric, which is attached to the remainder of the tubular body 32 for example by a seam or may be a region of fabric which is integrally formed with the remainder of the tubular body 32.

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Preferably the region of fabric 28 defines a leg opening 36 which has a diameter substantially the same as, or slightly smaller than, the diameter of leg on which the hose 30, 50 is intended to be worn.

- 10 Adoption of this size of leg opening 36 provides little or no compression on the wearer's leg and thereby avoids medical problems associated with a constrictive band. With such an arrangement, support of the hose on the wearer is predominantly achieved by the adhesive contact of the adhesive coating 20 with the wearer's skin.

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It is envisaged that the diameter of the leg opening 36 may be slightly greater than the diameter of the leg of the wearer. The extent to which the diameter of leg opening 16 may be greater than the leg of the wearer is determined more by the acceptability of the fit of the hose rather than the 20 hold-up function (i.e. if the diameter is too large, folds will be created around the leg of the wearer). Such a hose is, however, within the ambit of the present invention.

- 25 Since the hold-up function is predominantly determined by the adhesive contact between the wearer's skin and coating 20, it is envisaged that fabric region 28 may simply be formed from a fabric having a sufficient degree of stretch to enable the hose to be fitted onto the leg of the wearer.

Accordingly, the fabric region 28 may be formed of a fabric having no elastomeric yarns, e.g. it may be a fabric knitted entirely of non-elastomeric yarns such as a polyamide or a polyester.

- 5 Alternatively, the fabric may incorporate elastomeric yarns in order to provide a desired amount of elastic recovery or modulus of elasticity.

In this respect, it is envisaged that, when using an adhesive such as silicone gel, the fabric region 28 may impart a relatively high compressive force and 10 still provide an improve hold-up function. The utilisation of a silicone gel enables this to be achieved due to the cushioning affect of the gel (i.e. the gel spreads the compressive load of the fabric and helps reduce its constrictive effect).

- 15 This is advantageous in the production of hose since it enables a single size of hose to be worn by a wide range of differently sized wearers. In other words, the same size of hose may be worn by wearers having a leg diameter less or more than the diameter of the leg opening.

- 20 For the case where the wearer has a leg diameter greater than the diameter of the leg opening 16, the problem associated with roll over (i.e. where the end of the tubular body is caused to roll upon itself) is avoided by the adhesive contact between coating 20 and the wearer's skin.

- 25 It will be appreciated that tubular body 32 may be relatively short to define a sock.

Also, tubular body 32 may be open ended in foot region 34.

In embodiment 70 illustrated in Figure 3, the fabric of the tubular body 32 is knitted including an elastomeric yarn so as to define a compressive support stocking. The fabric region 28 is a separate band of fabric, preferably elasticated, which extends only partially around the circumference of the leg opening 36.

A V-shaped gusset insert 73 formed of a non-elasticated fabric is incorporated into the upper region of the tubular body 32.

10 The adhesive fabric 10 suitable for use as a band for attachment to a hose for performing a hold-up function is illustrated in Figure 4 and comprises a fabric substrate 11 coated on one side with a layer of a barrier material 12 which is in turn coated with a layer of an adhesive silicone gel 13.

15 This construction allows for only one side of the fabric substrate to exhibit adhering properties and avoids known problems of adhesive substances undesirably seeping through to the other side of the fabric. The layer of barrier material 12 lying between the fabric substrate 11 and silicone gel layer 13 prevents the transfer of silicone gel into the fabric.

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Rather than relying on frictional force alone to attach a fabric to the body, the adhesive fabric uses adhesion. By incorporating a gel having the desired level of tackiness to hold the fabric in place, the use of constrictive pressure is less significant.

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The silicone gel 13 is preferably of a type known as RTV 2K GEL TP 3841<sup>TM</sup> or "SILOPREN" gel TP 3904 as sold by GE Bayer Silicones GmbH & Co. KG. In its mixed state its viscosity is about 7500 MPas. This silicone gel exhibits an appropriate degree of stickiness that allows the

adhesive fabric to be easily peeled off the body without being too adhesive or not adhesive enough.

The thickness of the silicone gel layer is preferably chosen to provide a  
5 desired degree of adhesion to, for example, the skin of a body. Generally, the adhesive power is a function of thickness, viz. the thicker the layer of silicone gel, the greater the adhesive power.

Typically, the thickness of the silicone gel layer is chosen to be in the range  
10 of 0.01 to 0.5 mm, more preferably 0.2 to 0.4 mm, more preferably 0.3 to 0.33 mm.

Silicone gels are very suitable for direct use against the skin. Their soft nature encourages a cushioning effect and reduces pressure on the wearer.

15 Particularly in a medical environment, the use of silicone gels reduces irritation to burns, cuts and other wounds.

20 The gel also permits a degree of 'creep' when the fabric is adhered to the wearer i.e. slight movement of the fabric across the skin of the wearer.

Silicone gels are further capable of absorbing then slowly releasing a 'carried' solution such as antiseptic medication, vitamins and medicaments used in transdermal drug delivery.

25 Although not essential, the adhesive silicone gel can be sufficiently sticky to adhere to the fabric substrate when the adhesive fabric is wound around on itself. This is envisaged to be quite a useful feature when the adhesive fabric is to be used for applications other than hosiery, for example when

applied to surgical bandages. With hosiery applications this level of adhesion is not necessary as the adhesive fabric does not wind on itself.

After repeated wear, the stickiness of the adhesive gel may deteriorate  
5 particularly as it attracts dust, dead skin cells and other particles. However, the adhesive qualities of the adhesive fabric can be re-generated by washing the adhesive fabric (or garment) in a conventional manner. It is estimated that the adhesive fabric can be washed up to fifty times and still retain a satisfactory and workable level of adhesion.

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The barrier material 12 is preferably a silicone elastomer that is compatible with the fabric substrate for ensuring a strong bond between them. The barrier material is also preferably quick to cure thereby enabling the uncured barrier material to be extruded into the fabric substrate and cured  
15 before it penetrates too deeply into the fabric structure. Accordingly after application and curing of the barrier material, it will not have penetrated through to the opposite surface of the fabric. In its uncured state the barrier material preferably has a viscosity of about 30,000 to 180,000 MPas, more preferably 50,000 to 150,000 MPas.

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The fabric substrate 11 may be any type of knitted, woven or non-woven fabric made from natural and/or man made fibres.

25 The fabric may be a stretch or non-stretch fabric. For stretch fabrics, the fabric may include elastomeric yarns in order to provide the fabric with enhanced stretch recovery.

With this type of fabric a combination of adhesive and friction forces may operate to attach the fabric to the body.

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- As indicated above with reference to Figures 1 to 3, the invention is particularly useful in the holding up of stockings. In this application the fabric substrate comprises a band of fabric at the stocking top coated internally of the stocking with at least one band of cured silicone gel 13 bonded to the fabric via the layer of barrier material 12. Holding up of the stocking is achieved primarily by the adhesion qualities of the silicone gel 13 rather than a combination of surface friction and applied constrictive force.
- 10 The band of fabric at the stocking top which defines the substrate 12 may be defined by a separately applied band of fabric, such as for example a lace band, or may be defined by part of the stocking fabric. In the case of the fabric being an open fabric such as lace having a multitude of openings, it is envisaged that the open fabric may be formed in accordance with our 15 European patent 0922130 such that the adhesive coating does not extend over the holes in the fabric.

The thickness of the barrier layer is preferably chosen to be sufficient to ensure that an impervious layer is formed. Accordingly, for fabric substrates which are smooth and non-hairy, a thinner barrier layer may be adopted compared to a fabric having a rough and/or hairy surface. For fabrics having a hairy surface, it is desirable for the barrier layer to be thick enough to encapsulate therein the surface hairs in order to prevent the hairs acting as wicks.

25 The barrier layer 12 is preferably a silicone elastomer and may be chosen to be of a thickness to enhance the stretch recovery capabilities of the fabric substrate to which it is applied. Alternatively the thickness of the layer may be chosen such that they do not enhance the stretch recovery of the

underlying fabric, i.e. the fabric's stretch recovery properties are not materially affected by the applied barrier layer.

Typically, it is envisaged that the barrier layer will have a thickness in the  
5 range of 0.05 to 0.5 mm, more preferably in the range of 0.1 to 0.3 mm,  
more preferably 0.15 to 0.225 mm.

As indicated above with reference to Figures 1 to 3, the adhesive fabric of  
Figure 4 is particularly suitable for use as a hold-up for hose. It is also  
10 envisaged that this adhesive fabric may be also used to provide a hold-up  
facility with other types of garments such as strapless bras or low cut  
dresses. Another particular application for the present invention is as a  
medical bandage wherein the fabric substrate is a knitted stretch fabric.

15 Figure 4 schematically illustrates the production of the adhesive fabric 10.  
A length of fabric substrate 11 is fed continuously from a supply (not  
shown) past two extrusion heads and to a take-up reel (not shown). The  
first head 16 extrudes the silicone elastomer to form a film of barrier 12  
coating the fabric substrate.

20 In one embodiment, before reaching the second head 17 the barrier material  
12 is cured by the application of heat and so is prepared to be coated with  
the adhesive silicone gel.

25 The second extrusion head 17 supplies the adhesive gel 13. A thin coat of  
gel is extruded on top of the barrier material 12 as it moves past the second  
extrusion head.

30 The silicone gel is then cured by the application of heat. A release paper  
(not shown) is preferably laid upon the silicone gel layer during passage of

the adhesive fabric to the take-up reel to enable the fabric to be wound upon itself whilst protecting the adhesive.

In an alternative embodiment, curing of the silicone elastomer does not occur between extrusion heads 16, 17. Instead, the silicone gel is extruded onto the uncured silicone elastomer 12 and both the silicone elastomer and gel are cured simultaneously downstream of the extrusion head 17.

Preferably the silicone gel is a fast curing gel, for example has a cure time of less than 10 seconds. In its uncured state the adhesive silicone gel has a low viscosity. Without first coating the substrate with the barrier the silicone gel would penetrate through the fabric substrate. This would undesirably result in silicone gel being exposed on the uncoated side of the fabric substrate and thus undesirably render it sticky to the touch. This problem increases in proportion to the amount of silicone gel applied.

The construction of the adhesive fabric 10 avoids this problem and enables a fabric to be produced having only one adhesive side with the other side remaining unaffected by the adhesive gel irrespective of the amount of gel being applied.

As indicated above, it is envisaged that adhesive fabric according to the invention may find many uses. For example, it may be used as straps for holding in place garments or prostheses. It may also be used in lingerie to enable a garment to be held in place, e.g. a strapless bra.

It is also envisaged that fabric of the present invention may be used in applications where two pieces of the fabric are used with the intent of the gel coating of one piece of fabric adhering to the gel coating of another piece of fabric. With such an arrangement, the gel to gel bonding provides

a relatively high sheer strength with a relatively low peel strength. This enables the fabric pieces to be easily separated by a peeling action and subsequently re-attached to one another. Accordingly such an arrangement could be used in a similar manner to a hook and loop type fastener (of the 5 VELCRO® type) or any other type of application where a relatively high sheer strength and relatively low peel strength are required.

Accordingly, in another aspect, the present invention provides a fastener comprising a first component which is detachably securable to a second 10 component, the first and second components comprising a fabric having an adhesive surface defined by a layer of silicone gel.